

A Step Back in Time: Survey Historical Aerial Photograph Collections Find Expanded Use Across North Dakota

By Fred J. Anderson

The Survey maintains several collections of traditional paper aerial photographs (commonly called stereopairs), taken from as far back as 1938 (table 1). Most of these photos form the statewide county collection which consists of 10" black and white, 1:20,000-scale aerial photographs for each of the 53 counties in the state and spans the time frame from 1951 to 1965. These aerial photographic collection projects were flown for the various counties by the U.S. Department of Agriculture (USDA). There are over 41,000 photos contained in this collection (fig. 1). Digital images of every other photograph in this collection, as well as several others, can also be accessed online through the North Dakota State Water Commission's aerial imagery map service. In addition to the paper photos (fig. 2), the Survey also maintains this entire collection in a readily accessible digital archive of raw Tagged Image File Format (.tif) scans in the Bismarck office.

The value of these collections lies both in their temporal coverage, which, when used with today's aerial imagery cover a period of time of more than a half century, and use for stereoscopic viewing – a technique that generates an enhanced three-dimensional impression of the photographed landscape. Aerial photography collections that provide just the physical coverage of the landscape (typically every other photo along an aerial photo survey flight line at ~30% overlap) do not permit the stereoscopic viewing experience provided by the increased overlap (at ~60% between images) of aerial photograph collections that have every photo along the flight line (fig. 3). It is precisely this 3D viewing experience that provides Survey geologists the opportunity to view and delineate geologic features that may be difficult to discern from a ground-based perspective or from plain 2D digital images on a computer screen. Rendering digital imagery with

Table 1. Aerial Photograph Collections Available at the NDGS. The images in this collection are readily available for public inspection and use in the Bismarck office.

NDGS In-House Historical Aerial Photograph Collections

Name	Date	Scale	Area
USDA County Collection	1951-1965	1:20,000	Statewide-Individual Counties
Williston Basin Area	October 1951 & November 1952	1:66,3000	Williston Basin Counties from 100° to 104° west longitude
Quadrangle Collection	1937 - 1977	1:40,000 and larger, some at 1:12,500	Variable-Incomplete Coverage
Photomap Quadrangle Collection	July, 1952	1:63,360	Central Williston Basin-Lake Sakakawea from Bismarck to Trenton (pre-Dam)
Project 113 Collection	July - August, 1952	1:60,000	Eastern North Dakota Counties from 100° to 96° west longitude
Sheyenne National Grassland	June 29 & July 2, 2003	1:16,000	Sheyenne National Grasslands and surrounding area
Little Missouri River	1995	1:40,000	Little Missouri River Basin
Little Missouri National Grassland 2002	2002	1:15,840	Little Missouri National Grasslands and surrounding area
Grand River - Cedar River	1995	1:40,000	Grand River/Cedar River North Dakota

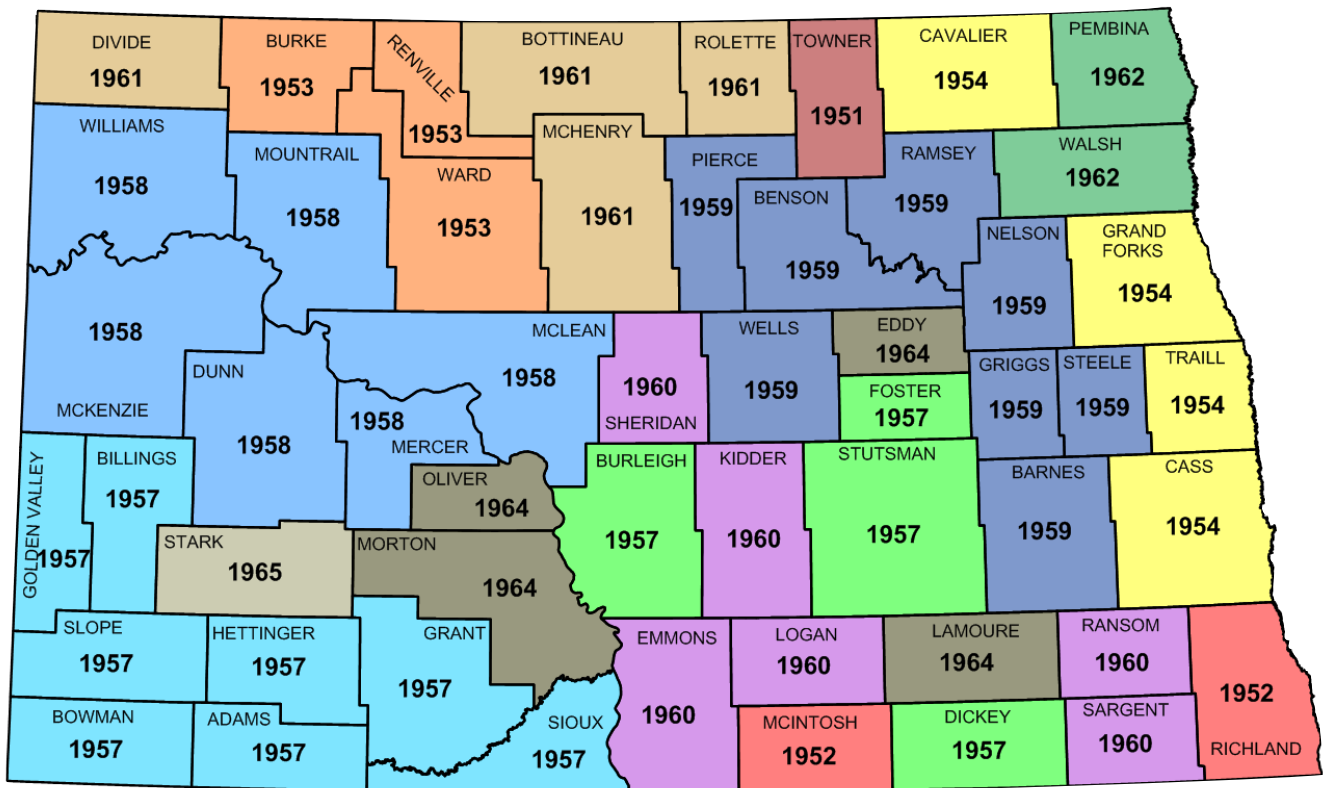


Figure 1. The dates flown for the historical aerial photography (paper & digital) in the Survey’s county aerial photo collection in Bismarck. Traditional black and white aerial photos (as well as digital images) with stereoscopic coverage and photo indexes are available for each county ranging from 1951 to 1965.



Figure 2. Historical aerial photography in the Survey’s County Collection is maintained in the Survey office in Bismarck. The county collection contains over 41,000 aerial photographs. Here, Survey geologist Levi Moxness reviews aerial imagery associated with ongoing landslide mapping work in eastern North Dakota.

digital elevation models, such as in the Google Earth platform, provides a pseudo-3D viewing experience which can be good for general viewing, but may not necessarily be suitable for detailed site-specific study, especially at the engineering scale. Additionally, the temporal aspect of the photographs permits the viewing of changes in the natural landscape over several decades,

whereas in other digital imaging platforms only recent imagery may be available. These photographs and digitally converted images are our only means of looking back into the recent history of the landscape and observing the natural and anthropogenic changes that have occurred.

A Unique Aerial Photo Acquisition Project

Fairchild Project C 17800 - 1952

Central Williston Basin North Dakota

Before the closure of the Garrison Dam in 1953 (fig. 4), a unique aerial photo survey was conducted in North Dakota by Fairchild Aerial Surveys. The history behind the influential Fairchild company and its enterprising founder Sherman Mills Fairchild (1896-1971) is grand and beyond the scope of this article, but is worth additional reading for those interested in the early historical development of aerial photography (Fairchild cameras were on the Apollo missions to the Moon in the 60s and early 70s). This aerial photography project was flown in 1952 and consisted of the acquisition of 628 individual aerial photos taken in seven flight lines across 17,942 square miles of western North Dakota along the pre-Lake Sakakawea portion of the Williston Basin, just edging into eastern Montana. These photographs were then assembled into 92 photomap quadrangles (sometimes referred to as orthophoto quads) at a scale of 1:63,360 (fig. 5). The Survey currently has 76 of these hardcopy orthophoto quads on hand that cover North Dakota (two short of the entire collection) at the Survey offices in Bismarck (fig. 6). Digital copies of the individual aerial photographs of the Elbowoods and Reservation Photomap Quadrangles (the two photomaps not in the North Dakota portion of the collection) are on hand in the Survey's digital image collection as a substitute for the original hard-copy photomaps.

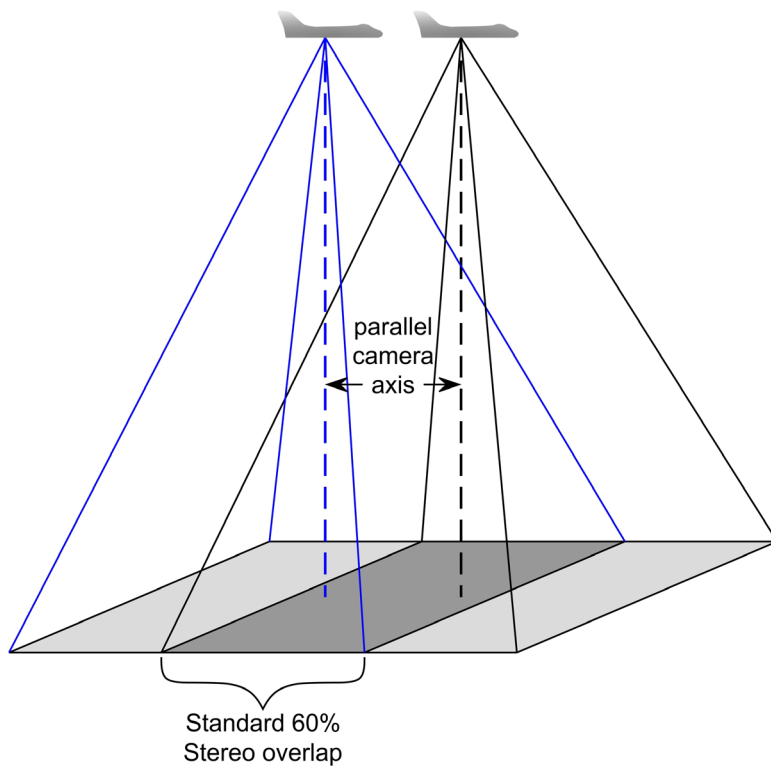


Figure 3. The overlap in land coverage from aerial photographs taken with stereoscopic coverage along a flight line is 60%. It is within this overlap that the parallax is provided for full stereoscopic viewing by use of a stereoscope in the office.



Figure 4. Example view from the Garrison photomap quadrangle showing the area of the Garrison Dam during construction in 1952.

The original aerial photos used to create the photomap quadrangles are currently archived in the extensive digital aerial photography collections housed at the University of California-Santa Barbara (UCSB): <https://www.library.ucsb.edu/src/collections-aerial-photography>. Digital scans of the original aerial photos can be ordered directly from the library online using their aerial imagery research service for a cost of \$20 per image.

The review of the natural landscape in three-dimensions, whether with traditional historical aerial photos or today's highly advanced LiDAR, based elevation models and map products provided by the Survey, is an essential part of a fundamental review of any geologic project. These aerial images enable a more comprehensive evaluation of any natural system or earth process.

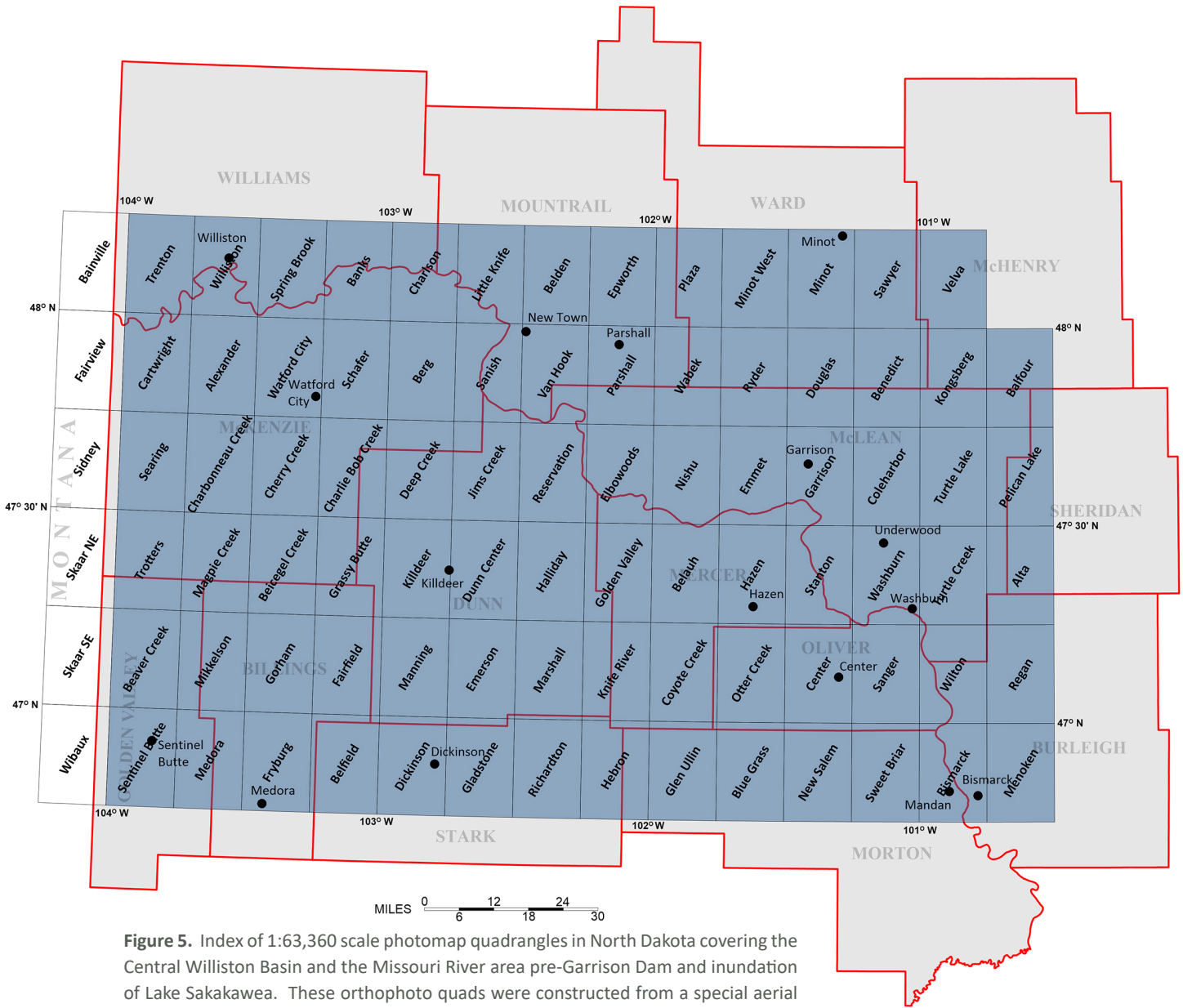


Figure 5. Index of 1:63,360 scale photomap quadrangles in North Dakota covering the Central Williston Basin and the Missouri River area pre-Garrison Dam and inundation of Lake Sakakawea. These orthophoto quads were constructed from a special aerial photography project flown by Fairchild Aerial Surveys in 1952.

Figure 6. The orthophoto quad is a unique aerial photography product. This collection of aerial photographs from 1952, before closure of the Garrison Dam, was assembled into photomap quadrangles that cover the entire pre-dam reach of the Missouri River. Here the author is viewing an aerial photomap of the Hazen area in support of ongoing proppant sand studies at the Survey.

